

You are invited to
FIND THE FUTURE

*at the Thirty-Seventh
North American
Manufacturing
Research Conference*

NAMRC 37

An International Forum



May 19-22, 2009

Greenville, South Carolina, USA

Hosted by

Clemson University

International Center for Automotive Research
(CU-ICAR)

Connect to the premier international forum for
academic research and industrial applications in
manufacturing!

<http://odce.clemson.edu/namrc/>



Society of
Manufacturing
Engineers

NAMRI 

North American Manufacturing
Research Institution of the
Society of Manufacturing Engineers



Dear Friends and Colleagues:

We are pleased to invite you to the Clemson University International Center for Automotive Research (CU-ICAR) for the 37th Annual North American Manufacturing Research Conference! NAMRC is the premier international forum for academic research and industrial applications in manufacturing. Global academic and industrial leaders in manufacturing attend this conference to interact with each other and advance the field.

The event will be held at the new home for the Clemson University Automotive Engineering Program, the Campbell Graduate Engineering Center, which is a 90,000 square foot facility dedicated to automotive research and education. We are located on the same campus as BMW's Information Technology Research Campus and Timken's Technology Center Greenville.

A series of workshops, industry panels and industry tours are planned for NAMRC 37, providing a unique opportunity to learn how clusters of companies from the Americas, Europe and Asia interact to realize collaborative product development and global manufacturing. The complete companion program allows participants to enjoy the beauty and culture of the South while experiencing cutting-edge manufacturing research in an atmosphere that promotes international collaboration.

We look forward to seeing you in South Carolina.

Regards,

Thomas R. Kurfess

Professor and BMW Chair of
Manufacturing
Director, Automotive Engineering
NAMRC 37 Conference Co-Chair
Clemson University
International Center for
Automotive Research
Greenville, South Carolina

John C. Ziegert

Professor and Timken Chair of
Automotive Design
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Automotive Research
Greenville, South Carolina



What is NAMRC—An International Forum

NAMRC is an international forum for the presentation and critical discussion of the results of basic and applied research in material forming, material removal and manufacturing systems and controls. It is one of only a few events of its kind where technical innovations, new methods and applications of leading-edge technology from throughout the world are shared among manufacturing research, design, engineering and production professionals from academia and industry. Because NAMRC takes place every year, the findings and breakthroughs presented here are topical and of current interest.

Why Should You Attend?

By attending NAMRC 37 you will:

- gain insight on the most recent developments in material removal and forming processes, automation and control of processes and systems, equipment accuracy and precision and many other manufacturing-related topics,
- participate in a dialogue between industry and academia on future needs for manufacturing processes and applications,
- enhance your knowledge of alternative manufacturing processes and applications,
- make valuable contacts with other leading manufacturing researchers and professionals.

About NAMRI/SME

The North American Manufacturing Research Institution of the Society of Manufacturing Engineers (NAMRI/SME) is an organization dedicated to manufacturing research and technology development. Its mission is to advance manufacturing engineering by promoting research and its application in industry. To learn more about NAMRI/SME or to become a member, visit the Web site at www.sme.org/namri.

Sponsorship

The NAMRC 37 Organizing Committee thanks our sponsors: Clemson University International Center for Automotive Research (CU-ICAR) and BMW Manufacturing Co. and GE Energy.



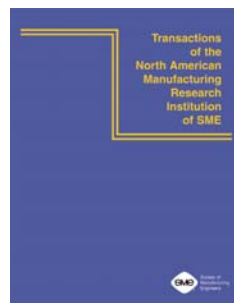
BMW Manufacturing Co.



**GE
Energy**

Conference Publication

Papers accepted for and presented at NAMRC 37 are contained in the hardbound *Transactions of NAMRI/SME*, Volume 37, 2009. Participants who have paid the registration fee will receive a copy at the time of registration along with a CD of the papers. Additional copies and past volumes (as available) of the *Transactions* may be purchased by contacting an SME Customer Service Representative at 313.425.3000, ext. 4500 or 800.733.4763.





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Conference Site & Facilities

The Clemson University International Center for Automotive Research (CU-ICAR) is an advanced technology research campus where academia, industry and government organizations engage in synergistic collaboration. The campus host facility is the new Carroll A. Campbell Jr. Graduate Engineering Center—the academic anchor for CU-ICAR’s Technology Neighborhood One, which also includes BMW’s Information Technology Research Campus and Timken’s Technology Center Greenville.

South Carolina is the heart of a newly emerging high-tech international automotive manufacturing and research sector, hosting numerous OEM and supplier production facilities, engineering units and research operations. With more than \$200 million in commitments, CU-ICAR represents the ultimate public/private partnership, directly fueling a knowledge base critical to the automotive industry.





Special Activities

In connection with NAMRC 37:

- NAMRI/SME Board Meeting, Tuesday, May 19, from 8:30 a.m. to 3:30 p.m. at the CU-ICAR, Campbell Graduate Engineering Center, Conference Room 423, 4th floor
- Welcoming Reception and Registration on Tuesday, May 19, from 6:00 to 8:00 p.m. at the Crowne Plaza Hotel (main conference hotel)
- Welcoming Ceremony on Wednesday, May 20, from 8:15 to 10:00 a.m. at the CU-ICAR, Campbell Graduate Engineering Center, AT&T Auditorium
- NAMRI/SME Awards Luncheon on Wednesday, May 20, from Noon to 1:45 p.m. in the Carolina First Gallery of CU-ICAR
- NAMRC Banquet on Wednesday, May 20, from 6:00 to 10:00 p.m. at the Crowne Plaza Hotel
- Founders Lecture by Klaus J. Weinmann on Thursday, May 21, from 11:45 a.m. to 1:45 p.m. in the Carolina First Gallery of CU-ICAR
- NAMRI/SME membership meeting on Thursday, May 21, from 3:45 to 4:45 p.m. in CGEC's AT&T Auditorium
- ASME/MED membership meeting on Thursday, May 21, from 4:45 to 5:45 p.m. in CGEC's AT&T Auditorium
- Reception, BMW Zentrum, 6:15 – 9:00 p.m.
- Industry tour at BMW Zentrum on Friday, May 22, from 12:30 to 3:00 p.m., meet in the Atrium at CGEC
- Companion program includes a walking tour of Falls Park in downtown Greenville and a visit to the South Carolina Botanical Gardens, Clemson, SC

Student Research Presentation Contest

NAMRC 37 will host the fourth annual Student Research Presentation Contest to recognize contributions to NAMRC and to encourage students to pursue a career in manufacturing research, which is of vital importance to the long-term goals of the manufacturing community. The contest is based on the student's oral presentation of a paper that he or she coauthors. The student presentations will be part of regular technical sessions and have the same time limitation. The presentations will be judged by a panel comprised of NAMRI/SME Honors Committee members or their delegates. The judges will not judge their own students. The judgment will be primarily based on clarity of presentation, including oral expression and use of visual aids. Originality and scientific merit of material presented may also be taken into account. First, second and third-place winners will be announced at the NAMRI/SME General Membership Meeting in the AT&T Auditorium on Thursday, May 21, 2009.



Industry Tour

Friday, May 22, 2009, 12:30–3:00 p.m.

Industry Tour at BMW Zentrum

BMW's only American factory is a marvel of the blending of modern engineering and design aesthetics. See for yourself how the ultimate driving machine is built during a guided plant tour. Or take a self-guided journey through time and all things BMW at the beautiful Zentrum museum, where you can explore BMW's dynamic history as one of the world's finest automakers. For the enthusiast, it's the ultimate backstage pass.

The BMW Zentrum Museum is unlike any other building in North America. Here you can experience the power and history of the BMW brand first hand, from its beginnings in aviation and motorsports to its rise to prominence on the global stage.

Take a self-guided trip through the world of BMW to experience exhibits that both astonish and inspire. Take a historical walk to see BMW's numerous milestones in both racing and touring vehicles. View rare and important vehicles from BMW's past, such as the famous Isetta "Bubblecar", BMW Motorcycles and Art Cars featuring designs by world-renowned figures like Andy Warhol, Frank Stella and Roy Lichtenstein. You can also explore what's current in BMW, with exhibits that feature state-of-the-art technologies in transportation safety and the latest in environmental engineering with the Hydrogen Car.

Tour Information:

- No high heels (heel and sole more than two inches high)
- No "spike" heels (minimum of 1 inch diameter across horizontal plane)
- No open toe or open heel shoes are permitted – shoes must be fully enclosed
- No cameras or camera phones are allowed inside the plant
- No children under 12 allowed on tour



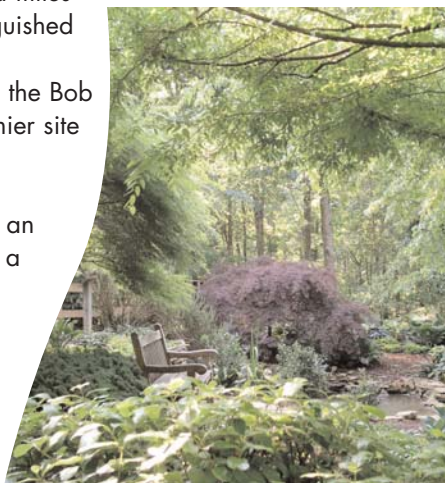
Companion Program

A variety of activities are being planned, and the participants will be consulted for the activities to best suit their interests. The plan will be modified per the interests of the companion program participants. The tentative plan is as follows:

South Carolina Botanical Gardens, Clemson, SC (Day 1)

The South Carolina Botanical Garden is a diverse 295 acres of natural landscapes, display gardens and miles of streams and nature trails. Together with distinguished education and outreach programs, a nationally recognized nature-based sculpture collection and the Bob Campbell Geology Museum, the SCBG is a premier site for experiencing nature and culture.

The South Carolina Botanical Garden is home to an official American Hosta Society Display Garden, a 70-acre arboretum, miles of nature trails and streams, a butterfly garden, wildflower meadow and fern and bog gardens. The Garden is also home to over 400 varieties of camellias, as well as an extensive collection of hollies, hydrangeas, magnolias and native plants.



Falls Park on the Reedy Tour

This is a 45-minute walking tour. This downtown public garden features the only curved, cantilevered pedestrian suspension bridge in the United States. The \$4.5 million Liberty Bridge does more than span the Reedy River—it serves as the focal point of Falls Park, showcasing man's creativity alongside nature's beauty. The bridge is 355 feet long, 12 feet wide, has a horizontal curve radius of 214 feet and 90-foot towers weighing 26 tons each.



The bridge's suspension towers lean downstream at a 15-degree angle. Subtle lighting in the bridge's handrails and from underneath gives it a glowing effect. Visitors truly will feel as if they are floating over the park. In addition to the Reedy River Falls, the bridge is the perfect place to view the magnificent public gardens below.



Registration Fees

To register online, visit www.odce.clemson.edu/namrc/.

To register by fax, print off a copy of the paper registration form and return a completed copy to our office. Faxed registrations must include credit card number and signature; keep your original if you register by fax. Payment must accompany registration. Payments are accepted via Visa, Amex, MasterCard, Discover Card, check, money order or purchase orders. Make checks/money orders payable to *Clemson University* and send them to:

NAMRC 37

Clemson University

P.O. Box 912

Clemson, SC 29633-0912

Phone: 864.656.2200

Fax: 864.656.7351

E-mail: jstange@clemson.edu

All fees are in U.S. dollars. Companion Program participants should complete their own registration form. Make additional copies of the form as needed.

All fees except the companion registration include entrance to all technical sessions, all conference materials, publications, meal functions and tours. Included in the companion registration fees are conference breakfasts, banquet and two receptions; and companion program tour (see Companion Program for details).

There are no single-day registration fees. There are no reduced registration fees for authors or session chairs. Student attendees do not receive the *Transactions of NAMRI/SME*.

Cancellation and Refunds

Refunds, less an administrative fee of U.S. \$100, will be issued for all cancellations received in writing before May 11, 2009. No refunds will be made after that date, but a substitution of attendees may be made by notifying Conference Services prior to the conference. Please allow six to eight weeks to receive check refunds. Credit card refunds will be issued to the credit card that made the payment. Those who register but fail to cancel by the deadline and do not attend the conference will not be eligible for a refund. Should this event cancel in entirety, Clemson University's liability is limited to a refund of the registration fees paid.





Travel and Accommodation Information

All international participants are responsible for their own visa and health insurance needs.

Crowne Plaza Hotel (host hotel)

851 Congaree Rd
Greenville, SC 29607
Toll Free: 888.233.9527

NAMRC 37 room rate (Single/Double):
\$109 USD includes full buffet breakfast coupon
(reservation prior to May 1, 2009). Free parking.

<http://odce.clemson.edu/namrc/>

(Select: Accommodations)

Drury Inn & Suites

10 Carolina Point Parkway
Greenville, SC 29607
864.288.4401

Fax: 864.288.4401

Room rate (Single/Double): \$94-\$100 USD
includes complimentary breakfast. Free parking.

<http://www.druryhotels.com/PropertyOverview.aspx?Property=0132>

Embassy Suites Greenville Golf Resort & Conference Center

670 Verdae Boulevard
Greenville, SC 29607
864.676.9090

Fax: 864.676.0669

Room Rate: Single \$149, Double \$159 includes complimentary breakfast. Free parking.

www.embassysuites.com

Visit the NAMRC 37 Web site at

<http://odce.clemson.edu/NAMRC/> for more information about:

Dining near conference hotels

Greenville attractions

Explore Greenville

Set among the foothills of the Blue Ridge Mountains in the northwest corner of South Carolina, Greenville's vibrant community welcomes visitors to experience breathtaking views and Southern charm at its finest through Greenville... from the Liberty Bridge, a 355-foot pedestrian walkway overlooking the historic waterfalls nestled in the heart of downtown, to panoramic views from the mountains.



Directions to CU-ICAR

By Air

Greenville-Spartanburg International Airport (GSP) is located in upstate South Carolina, midway between the cities of Greenville and Spartanburg on I-85 (Exit 57). GSP has grown into one of the finest airports in the country, steadily meeting ever-increasing needs.

<http://www.gspairport.com>

Cab/Taxi

There are official taxi and shuttle services from the airport to any part of Greenville. For travel reservations, please call toll-free at 877.287.2001. Your advanced reservations will ensure your timely departure. But we're here for you on short notice when plans change or emergencies arise.

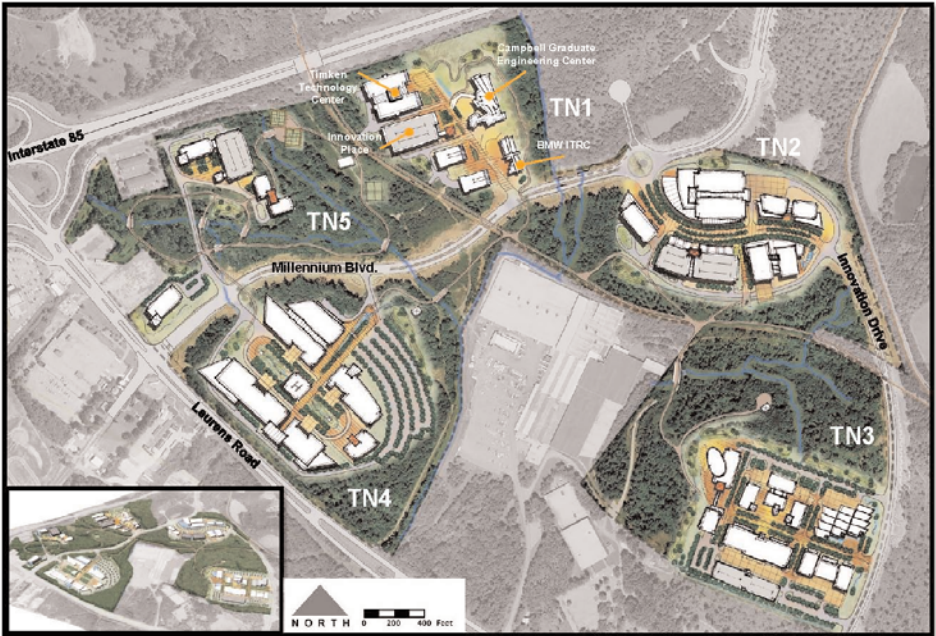
Hotel to CU-ICAR Transportation

There will be shuttle trips from the Crowne Plaza Hotel to the CU-ICAR campus. For those not staying at the conference hotel, the recommended means of transportation is personal vehicle or city taxis at 877.287.2001. There is adequate and free parking at CU-ICAR.

Driving from Interstate 85 to CU-ICAR

From Interstate 85, take Exit 48A East (Highway 276 East, Laurens Road) toward Mauldin, SC. At the first traffic light, turn left on Millennium Boulevard. Continue for approximately a half mile. Turn left after the railroad tracks onto Research Drive. Proceed to the next left and turn into the AutoPark. The meeting will be held in the Carroll A. Campbell Jr. Graduate Engineering Center (CGEC). For further driving instructions, please see **<http://www.clemson.edu/centers-institutes/cu-icar/campus/directions.html>**

Clemson University International Center for Automotive Research (TN1)*



*Complexes TN2, TN3, TN4 and TN5 under development

Climate

The average high temperature for Greenville in May is 78 degrees Fahrenheit. The average low is 59 degrees Fahrenheit. Please check the weather forecast for the area before leaving for your visit.

How to Register – Online or Fax

Online registration at: <http://odce.clemson.edu/namrc/>

For fax, complete the registration form at the back of the program brochure. If faxing, please fax with your payment information to:

Clemson University, NAMRC 37

Fax: 864.656.7351

For information regarding the conference registration process, please contact Clemson University at 864.656.2200 or e-mail: jistange@clemson.edu



NAMRC 37

Technical Sessions and Programs

TUESDAY, MAY 19, 2009

8:30 a.m. – 3:30 p.m.

NAMRI/SME Board Meeting

CGEC, Conference Room 423

3:45 p.m.

Transportation to Crowne Plaza Hotel

6:00 p.m. – 8:00 p.m.

Conference Registration and Welcoming Reception

Crowne Plaza Hotel – Haywood Room

WEDNESDAY, MAY 20, 2009

7:15 a.m. – 8:15 a.m.

Registration and Breakfast

CGEC, Atrium

8:15 a.m. – 10:00 a.m.

Welcoming Ceremony

CGEC, AT&T Auditorium

The Green Plant

Speaker: Mr. Douglass Bartow, Vice President of Paint Technology,
BMW Manufacturing Company

Hybrid Technology Integration into the X6 Production System

Speaker: Mr. Cevin Bryant, Plant Project Leader – E72 (X6 Hybrid),
BMW Manufacturing Company

10:00 a.m. – 10:30 a.m.

Morning Coffee Break

CGEC, Atrium

10:30 a.m. – Noon

Concurrent Technical Sessions



Session A-1-1: Forming 1

CGEC, Room 401

Chair: Jun Qu, Oak Ridge National Laboratory

Co-Chair: Muammer Koç, Virginia Commonwealth University

Analytical Prediction of Shifting Behavior in Strain-Based Sheet Forming Limit Curves for Sheet Metal Using a Stress-Based Failure Criterion

Brad L. Kinsey, Matthew Derov, Igor Tsukrov

Studying Micro Deep Drawing Process Through Drawing Brass Micro Cups
Jenn-Terng Gau, Chi-Han Chen, Zhong-Yi Yang

Double-Diaphragm Forming of Advanced Composite Shapes with Active Tool Shape and Temperature Control

Daniel Walczyk, Chris Munro

Evolutionary Stamping Die Development Using Morphing Technology

Liang Zhou*, S. Jack Hu, Guosong Lin, Thomas B. Stoughton

Session B-1-1: Monitoring and Wear

CGEC, Room 404

Chair: Sarang Garud, Third Wave Systems

Co-Chair: Ruben Morales Menéndez, Tecnológico de Monterrey

Sensor Placement Strategy for Stamping Tooling Integration Based on Geometric Methods

Sripati Sah*, Robert X. Gao

Tool Wear Monitoring for Milling by Tracking Cutting Force Model Coefficients
Yanjun Cui, Barry K. Fussell, Robert B. Jerard, Donald M. Esterling

Micro Rotary Ultrasonic Machining

Murali M. Sundaram, Aarati Sarwade, Krishna Rachuri, K.P. Rajurkar

Effect of Minimum Quantity Lubrication (MQL) with Nanofluids on Grinding Behavior and Thermal Distortion

Uppiliappan Sridharan, Stephen Malkin



NAMRC 37 Program

Hosted by the **Clemson University International**
Greenville

Morning

<p>Tuesday May 19</p>	<p>NAMRI/SME B... Campbell Graduate Engi... Conference I... 8:30 a.m. –</p>			
<p>Wednesday May 20</p>	<p><i>Registration & Breakfast</i> Atrium 7:15 – 8:15 a.m.</p>	<p><i>Welcoming Ceremony</i> AT&T Auditorium 8:15 – 10:00 a.m.</p>	<p><i>Morning Coffee Break</i> Atrium 10:00 – 10:30 a.m.</p>	<p><i>Concurrent Sessions</i> Room 401 Room 404 Room 405 10:30 a.m. – Noon</p>
<p>Thursday May 21</p>	<p><i>Registration & Breakfast</i> Atrium 7:15 – 8:15 a.m.</p>	<p><i>Concurrent Sessions</i> Room 401 Room 404 Room 405 Room 406 8:15 – 9:45 a.m.</p>	<p><i>Morning Coffee Break</i> Atrium 9:45 – 10:15 a.m.</p>	<p><i>Concurrent Sessions</i> Room 401 Room 404 Room 405 Room 406 10:15 a.m. – 11:45 a.m.</p>
<p>Friday May 22</p>	<p><i>Registration & Breakfast</i> Atrium 7:30 – 8:30 a.m.</p>	<p><i>Concurrent Sessions</i> Room 401 Room 404 Room 406 8:30 – 10:00 a.m.</p>	<p><i>Morning Coffee Break</i> Atrium 10:00 – 10:30 a.m.</p>	<p><i>Concurrent Sessions</i> Room 401 Room 404 10:30 a.m. – Noon</p>



Program-at-a-Glance

International Center for Automotive Research (CU-ICAR),
Clemson, SC, USA

Afternoon			Evening	
<p>Board Meeting</p> <p>Engineering Center (CGEC) Room 423</p> <p>1:30 p.m.</p>			<p>Registration Crowne Plaza Hotel 6:00 – 8:00 p.m.</p> <p>Reception Crowne Plaza Hotel 6:00 – 8:00 p.m.</p>	
<p>Awards Luncheon</p> <p>Carolina First Gallery</p> <p>Noon – 1:45 p.m.</p>	<p>Concurrent Sessions Room 401 Room 404 Room 405</p> <p>2:00 – 3:30 p.m.</p>	<p>Afternoon Coffee Break</p> <p>Atrium</p> <p>3:30 – 3:45 p.m.</p>	<p>Concurrent Sessions Room 401 Room 404 Room 405</p> <p>3:45 – 5:15 p.m.</p>	<p>Banquet</p> <p>Crowne Plaza Hotel</p> <p>6:00 – 10:00 p.m.</p>
<p>Founders Lecture and Luncheon</p> <p>Carolina First Gallery</p> <p>11:45 a.m. – 1:45 p.m.</p>	<p>Plenary Talk on Sustainable Manufacturing</p> <p>AT&T Auditorium</p> <p>1:45 – 2:30 p.m.</p>	<p>Technical Tours CGEC, Timken Technology Center, BMW Information Technology Research Center</p> <p>2:30 – 3:45 p.m.</p>	<p>NAMRI/SME Membership Meeting</p> <p>Room 401</p> <p>3:45 – 4:45 p.m.</p>	<p>ASME Membership Meeting Room 401 4:45 – 5:45 p.m.</p> <p>Bus leaves for BMW 5:45 p.m.</p> <p>HR Panel and Reception BMW Zentrum 6:15 – 9:00 p.m.</p>
<p>Closing Ceremony and Box Lunch</p> <p>Atrium</p> <p>Noon – 12:30 p.m.</p>	<p>Industry Tour at BMW Production Facilities</p> <p>12:30 – 3:00 p.m.</p>			

OVERVIEW OF TECHNICAL SESSION TRACKS AND SCHEDULE

	CGEC Room 401	CGEC Room 404	CGEC Room 405	CGEC Room 406
Wednesday May 20				
10:30–12:00	Session A-1-1 <i>Forming 1</i>	Session B-1-1 <i>Monitoring and Wear</i>	Session C-1-1 <i>Manufacturing Systems 1</i>	—
2:00–3:30	Session A-1-2 <i>Forming 2</i>	Session B-1-2 <i>Specialized Processing</i>	Session C-1-2 <i>Manufacturing Systems 2</i>	—
3:45–5:15	Session A-1-3 <i>Forming 3</i>	Session B-1-3 <i>Advanced Machining 1</i>	Session C-1-3 <i>Manufacturing Systems 3</i>	—
Thursday May 21				
8:15–9:45	Session A-2-1 <i>Forming 4</i>	Session B-2-1 <i>Advanced Machining 2</i>	Session C-2-1 <i>Quality & Metrology 1</i>	Session D-2-1 <i>Thin Film Systems</i>
10:15–11:45	Session A-2-2 <i>Advanced Machining 3</i>	Session B-2-2 <i>Machining Systems</i>	Session C-2-2 <i>Machining & Lubrication</i>	Session D-2-2 <i>Novel Processes 1</i>
Friday May 22				
8:30–10:00	Session A-3-1 <i>Advanced Machining 4</i>	Session B-3-1 <i>Novel Processes 2</i>	Session C-3-1 <i>Quality & Metrology 2</i>	—
10:30–12:00	Session A-3-2 <i>Advanced Machining 5</i>	Session B-3-2 <i>Quality & Metrology 3</i>	—	—

Session C-1-1: Manufacturing Systems 1

CGEC, Room 405

Chair: John Agapiou, General Motors Corporation

Co-Chair: Satyandra Gupta, University of Maryland

Reducing Environmental Impacts of Steel Product Manufacturing

Karl R. Haapala, Julio L. Rivera, John W. Sutherland

GPU-Accelerated SIMT Tabu Search for the Quadratic Assignment Problem

Weihang Zhu, James Curry, Alberto Marquez

Addressing Process Planning and Verification Issues with MTConnect

Athulan Vijayaraghavan, Lucie Huet, David A. Dornfeld, William Sobel,
Bill Blomquist, Mark Conley

Enabling Manufacturing Research Through Interoperability

David A. Dornfeld, Paul K. Wright, Athulan Vijayaraghavan, Moneer Helu

Noon – 1:45 p.m.

NAMRI/SME Awards Luncheon

Carolina First Gallery

2:00 p.m. – 3:30 p.m.

Concurrent Technical Sessions

Session A-1-2: Forming 2

CGEC, Room 401

Chair: Gracious Ngaile, North Carolina State University

Co-Chair: R.T. Eluri, Oregon State University

*Influence of Substrate Material on Wear Performance of Stamping Dies Utilizing a
New Die Wear Test System*

Ömer N. Cora*, Muammer Koç

*Anisotropy of Plastic Deformation in Micro/Meso-Scale Metal Forming –
Development of Testing Method*

Takehiko Makino, Kuniaki Dohda, Akihiro Ishitani, Hualing Zhang

Formability of Austenitic Stainless Steels Under Warm Hydroforming Conditions

Eren Billur, Sasawat Mahabunphachai, Muammer Koç

Forming Al-Al₂O₃ Nanocomposite Surfaces Using Friction Stir Processing

Jun Qu, Hanbing Xu, Zhili Feng, Ke An, Rick Battiste, Linan An, Helge Heinrich



Session B-1-2: Specialized Processing

CGEC, Room 404

Chair: Bob Jerard, University of New Hampshire

Co-Chair: Chris Suprock, Suprock Technologies

Micro Glass Milling on Multi-Axis Machine Tool

Takashi Matsumura, Keisuke Minai, Yiming Kevin Rong

Optimized Recurrent Neural Network-Based Tool Wear Modeling in Hard Turning

Xiaoyu Wang*, Yong Huang

Time Delay in Controller Area Network (CAN)-Based Networked Control Systems

Rodrigo Vargas Rodriguez*, Rubén Morales-Menéndez, Ricardo A. Ramirez

Mendoza, Luis E. Garza Castañon

Prediction of Distortion in Thin-Walled Machined Components

T.D. Marusich, S. Usui, S. Lankalapalli, K. Marusich, S. Garud, L. Zamorano

Session C-1-2: Manufacturing Systems 2

CGEC, Room 405

Chair: Dave Dornfeld, University of California-Berkeley

Co-Chair: Dave Kim, Washington State University-Vancouver

Intelligent Monitoring of Microassembly Process of High-Precision

Spindle Motor Parts

Somkiat Tangjitsicharoen, Napassavong Rojanarowan, Pirat Tangpornprasert,

Chanyaphan Virulsri

Cyclic Waveform Signal Analysis for Online Monitoring of Valve Seat

Assembly Processes

Yong Lei*, Kamran Paynabar, Judy Jin, John Agapiou

Comparison of Anisotropic and Inertial Effects in Single Crystals Under

Microscale Laser Shock Peening

Siniša Vukelić, Jeffrey W. Kysar, Y. Lawrence Yao

Characterization and Control of Pin Diameter During In-Mold Assembly of


Mesoscale Revolute Joints

Arvind Ananthanarayanan*, Satyandra K. Gupta, Hugh A. Bruck

3:30 p.m. – 3:45 p.m.

Afternoon Coffee Break

CGEC, Atrium



3:45 p.m. – 5:15 p.m.

Concurrent Sessions

Session A-1-3: Forming 3

CGEC, Room 401

Chair: Brad Kinsey, University of New Hampshire

Co-Chair: Dan Walczyk, Rensselaer Polytechnic Institute

Nonlinear Finite Element Analysis of Metal Powder Die Compaction Using Various Plasticity Models

Hossein Kashani Zadeh*, Il Yong Kim, Jack Jeswiet

Diffusion Brazing of Aluminum Alloys for Micro Heat Exchanger Applications

R.T. Eluri*, B.K. Paul

Online Classification of Surface Defects in Hot Rolling Processes

Qingyu Yang, Qiang Li, Judy Jin, Tzzy-Shuh Chang

Application of Finite Element Simulation in Metal Forming Tribology

Gracious Ngaile, Chen Yang*

Session B-1-3: Advanced Machining 1

CGEC, Room 404

Chair: Robert Gao, University of Connecticut

Co-Chair: Ömer Cora, Virginia Commonwealth University

Effect of Surface Texture and White Layer by Hard Turning vs. Grinding on Frictional Performance

R.A. Waikar*, Y.B. Guo

Performance Evaluation of Vegetable Oil as an Alternative Cutting Lubricant When End Milling Stainless Steel Using TiAlN Coated Carbide Tools

S. Sharif, M.A. Hisyam, D. Kurniawan, E.A. Orady

In-Process Monitoring and Identification of Cutting States Based on Power Spectrum Density Analysis

Somkiat Tangjitsitcharoen

Surface Roughness Modeling in Peripheral Milling Processes

Antonio Vallejo*, Ruben Morales-Menéndez, Hugo Elizalde-Siller



Session C-1-3: Manufacturing Systems 3

CGEC, Room 405

Chair: Haritha Metta, University of Kentucky

Co-Chair: Karl Haapala, Michigan Technological University

A State-Space Heuristic for Adaptive Production Control in One-of-a-Kind Production

Wei Li*, Barrie R. Nault, Yiliu Tu, Deyi Xue

An Ecogenic Multi-Agent Framework for STEP-Compliant Manufacturing: An Artificial Immune System Based Approach

M. Bachlaus*, F.F. Chen, G. Kuriger

A Low Cost Flying Robot for Deploying Ad Hoc Wireless Sensors in a Manufacturing Environment

Christopher A. Suprock*

Densification and Dimensional Accuracy of Metal Matrix Composites Fabricated by Three Dimensional Printing

Li Sun, Patrick Kwon, Yongha Kim, Dave (Dae-Wook) Kim

5:15 p.m.

Transportation to Crowne Plaza Hotel

6:00 p.m. – 10:00 p.m.

NAMRC Banquet

Crowne Plaza Hotel, Metropolitan Ballroom

Speaker: Prof. Dr.-Ing. Günter Warnecke, University of Kaiserslautern
Complexity of Products and Processes Requires New Strategies and Models in Research and Application of Manufacturing

THURSDAY, MAY 21, 2009

7:15 a.m. – 8:15 a.m.

Registration and Breakfast

CGEC, Atrium

8:15 a.m. – 9:45 a.m.

Concurrent Technical Sessions



Session A-2-1: Forming 4

CGEC, Room 401

Chair: Yuebin Guo, University of Alabama

Co-Chair: Hossein Zadeh, Queen's University

Tensile Formability Enhancement of Magnesium AZ31B-0 Alloy Using Electrical Pulsing

Wesley A. Salandro*, Ashraf Khalifa, John T. Roth

Strains Generated in Selected Regions for an Intelligent Die During Stamp Forming
William J. Emblom, Klaus J. Weinmann, John E. Beard

Springback Elimination for Al-6111 Alloys Using Electrically Assisted Manufacturing (EAM)

Chad R. Green*, Timothy A. McNeal, John T. Roth

Roughness Evaluation of Single Point Incrementally Formed Surfaces
M. Ham, B. Powers, C.A. Brown, J. Jeswiet, K. Hamilton*

Session B-2-1: Advanced Machining 2

CGEC, Room 404

Chair: Simon Park, University of Calgary

Co-Chair: Peter Herzenstiel, University of Kaiserslautern

High-Speed Microvideography Observations of the Periodic Catastrophic Shear Event in Cutting AISI 1045 Steel

Jarred C. Heigel

Laser Micromachining and Quality Improvement by Cyanoacrylate Coating on Silicon Wafer

Plawut Wongwiwat, Roger J. Narayan, Yuan-Shin Lee

Blade Oblique Cutting of Tissue for Investigation of Biopsy Needle Insertion

Jason Z. Moore*, Carl S. McGill, Albert J. Shih, Patrick W. McLaughlin, Qinhe Zhang, Haojun Zheng

Coupled Torsional-Axial Vibrations of Micro and Macro Drills

Sinan Filiz*, O. Burak Ozdoganlar

Session C-2-1: Quality & Metrology 1

CGEC, Room 405

Chair: John Ziegert, Clemson University

Co-Chair: Mohamed El Mansori, Direction de l'Ingénierie Process, Arts et Métiers ParisTech



Multi-Objective Adaptive Job Shop Scheduling Using Genetic Algorithms
Hariitha Metta*, Fazleena Badurdeen

Method to Measure Planar Displacement Using Centroid Calculation
Carlos A. Montes*, John C. Ziegert, Laine Mears

Increasing Adaptability of Assembly Planning and Control with Embedded Decision-Making Capability
Shadi Keshavarzmanesh*, Lihui Wang, Hsi-Yung (Steve) Feng

Novel Heterodyne Displacement Measuring Interferometer
Hyo Soo Kim*, Tony L. Schmitz

Session D-2-1: Thin Film Systems

CGEC, Room 406

Chair: Kevin Chou, University of Alabama

Co-Chair: Qiang Li, University of Manitoba

Dynamic Fatigue Life Testing of Palladium-Chromium Thin-Film Micro Strain Gages Fabricated on Superalloy Substrate
Mike Miller, Dirk Werschmoeller, Xiaochun Li

A Process for Manufacturing Very Thin PDMS Films
Sriram Krishnan*, Sanjay Sarma

Study on PdCr Thin Film Sensors Embedded in Ti6Al4V Alloys Through Diffusion Bonding
Xugang Zhang, Hongrui Jiang, Xiaochun Li

9:45 a.m. – 10:15 a.m.

Morning Coffee Break

CGEC, Atrium

10:15 a.m. – 11:45 a.m.

Concurrent Technical Sessions

Session A-2-2: Advanced Machining 3

CGEC, Room 401

Chair: Shreyes Melkote, Georgia Institute of Technology

Co-Chair: Wes Salandro, Penn State Erie

Mechanistic Force Modeling of Micro Ball End Milling Processes
Mohammad Malekian*, Simon S. Park, Mozhdeh Sajjadi, Martin B.G. Jun



Pressure and Temperature Effects in Micro-Laser Assisted Machining (μ -LAM) of Silicon Carbide

Amir R. Shayan*, H. Bogac Poyraz, Deepak Ravindra, John A. Patten

Experimental Investigation of Wet and Dry Grinding Using a Grinding Wheel with a Defined Grain Pattern

Peter Herzenstiel, Jan C. Aurich

Session B-2-2: Machining Systems

CGEC, Room 404

Chair: Jarred Heigel, National Institute of Standards and Technology

Co-Chair: John Roth, Penn State Erie

Producing Micro Scale Silicon Dioxide Gears by Bulk Micro Machining Process

M. Todd McGregor*, Hugo A. Mahlke, Sean M. Dozier,
Bahram Asiabanpour, Dugan Um

A New "Super Diagram" for Describing Milling Dynamics

Raúl E. Zapata*, Tony L. Schmitz

Helical Milling for Hole Making in Nickel-Based Alloy with Ball-End Mill

David Olvera, Ciro A. Rodríguez, Alex Elías-Zúñiga, Gorka Urbicain,
Luis Norberto López de Lacalle

Rotary Ultrasonic Machining of Stainless Steel: Design of Experiments

Weilong Cong*, Z.J. Pei, N.J. Churi, Qianguo Wang

Session C-2-2: Machining & Lubrication

CGEC, Room 405

Chair: Albert Shih, University of Michigan

Co-Chair: Burak Ozdoganlar, Carnegie Mellon University

How Strains and Strain Rates are Accommodated by Dislocations and Twins During Chip Formation by Machining

S. Shekhar, J. Cai, S. Lee, J. Wang, M.R. Shankar

Solubility of a Metalworking Lubricant in High-Pressure CO₂ and Effects in Three Machining Processes

Andres F. Clarens, Douglas J. Maclean, Kim F. Hayes, Ye-Eun Park,
Steven J. Skerlos

Cutting Edge Radius Effects on Diamond-Coated Tools

Feng Qin, Kevin Chou, Dustin Noland, Raymond G. Thompson, Wangyang Ni

Toward an Objective 3D Description for Quality Assessment of Manufactured Honed Surfaces

Leila Sabri*, Sabeur Mezghani, Mohamed El Mansori, Jean-Vincent LE LAN



Session D-2-2: Novel Processes 1

CGEC, Room 406

Chair: Yuan-Shin Lee, North Carolina State University

Co-Chair: Sriram Krishnan, Massachusetts Institute of Technology

Nanofoamed High-Performance Polymer Nanocomposites

Nicholas J. Vaccaro*, Wei Li, Bin Li, W.H. Katie Zhong

Fabrication and Characterization of Micro Dent Array Produced by Laser Shock Peening on Aluminum Surfaces

R. Caslaru*, M.P. Sealy, Y.B. Guo, S.C. Chen

Modeling of a Plastic Lumber Extrusion Process

Jeffery Kirkham, Wei Li, Vipin Kumar

11:45 a.m. – 1:45 p.m.

Founders Lecture Luncheon

CU-ICAR, Carolina First Gallery

Speaker: Klaus J. Weinmann, Professor Emeritus, Michigan Technological University

1:45 p.m. – 2:30 p.m.

Plenary Seminar on Sustainability as a Customer Relevant Characteristic of the Complete Vehicle

Dr. Julian Weber, Manager of Vehicle Product Strategy, BMW AG
CGEC, AT&T Auditorium

2:30 p.m. – 3:45 p.m.

Technical Tours of CGEC, BMW – Information Technology Research Center (BMW-ITRC) and Timken Technology Center Greenville

Leave from CGEC Atrium

3:45 p.m. – 4:45 p.m.

NAMRI/SME Membership Meeting

CGEC, AT&T Auditorium


4:45 p.m. – 5:45 p.m.

ASME/MED Membership Meeting

CGEC, 401

5:45 p.m.

Bus leaves for BMW Zentrum Reception



6:15 p.m. – 7:30 p.m.

Panel Discussion on Human Resources in the Modern Manufacturing Environment

BMW Zentrum

Kathleen Wall – Vice President of Human Resources, BMW Manufacturing

Laurie Burrell – Recruiting Manager, Michelin North America, Inc.

Marcella Kimbrell – Principal Organizational Advancement Analyst,
The Timken Company

7:30 p.m. – 9:00 p.m.

Reception

9:00 p.m.

Buses Return to Crowne Plaza Hotel

FRIDAY, MAY 22, 2009

7:30 a.m. – 8:30 a.m.

Registration and Breakfast

CGEC, Atrium

8:30 a.m. – 10:00 a.m.

Concurrent Technical Sessions

Session A-3-1: Advanced Machining 4

CGEC, Room 401

Chair: Shiv Kapoor, University of Illinois

Co-Chair: Yong Huang, Clemson University

Development of the 3D Engraving System from 2D Images

Won-Seck Lee, Sung-Chong Chung

An Experimental Comparative Study of Chip Morphology, Chip Flow Speed, and Cutting Forces in High-Speed Machining of Ti-6Al-4V and Inconel 718

N. Fang, Q. Wu, S. Mosquea

Effect of Drill Wear on Interfacial Burr Size for Different Drill Geometries

Cody Hellstern, John B. Morehouse, Shreyes N. Melkote, S. Turner

Improved Boring Bar Dynamic Stiffness Through a Tuned Holder Design

Lonnie Houck III, Tony L. Schmitz, K. Scott Smith



Session B-3-1: Novel Processes 2

CGEC, Room 404

Chair: Luis de Leon, Leibniz Universität Hannover

Co-Chair: Will Emblom, University of Louisiana at Lafayette

Three-Dimensional Digital Halftoning for Layered Manufacturing Based on Droplets
Chi Zhou, Yong Chen

A Manufacturing Framework for Biomimetic Porous Metals
Steven R. Schmid, Paul S. Nebosky, Greg Stalcup

Rapid Prototyping of Bulk δ H-SiC MEMS Structures Using a Q-Switched Nd:YAG Laser
Ben F. Pecholt, Pal A. Molian

Data to Information: Can MTConnect Deliver the Promise?
Sri H. Atluru, Amit Deshpande

Session C-3-1: Quality & Metrology 2

CGEC, Room 405

Chair: Wenzhen Huang, University of Massachusetts Dartmouth

Co-Chair: Qingjin Peng, University of Manitoba

Wear of WC-Co Inserts in Dry Machining of Submicron Particle Size Aeronautical Grade Near- β Titanium Alloy
H.A. Abdel-Aal, M. El Mansori, M. Nouari

Reducing the Environmental Footprint and Economic Costs of Automotive Manufacturing Through an Alternative Energy Supply
Chris Y. Yuan*, David A. Dornfeld

Parametric Investigation of Precision in Tool-Workpiece Conductivity Touch-Off Method in Micromilling
Angela A. Sodemann, J. Rhett Mayor

Implementation of a Metrology Frame to Improve Positioning of Micro/Meso-Scale Machine Tools
Shawn P. Moylan, Bradley Damazo, M. Alkan Donmez

10:00 a.m. – 10:30 a.m.

Morning Coffee Break

CGEC, Atrium

10:30 a.m. – Noon

Concurrent Technical Sessions



Session A-3-2: Advanced Machining 5

CGEC, Room 401

Chair: Laine Mears, Clemson University

Co-Chair: Chan Wong, Clemson University

Characteristic Values for Continuous-Generating Grinding of Gears

Berend Denkena, Luis de Leon, Frank Stimpel

Minimum Quantity Lubrication (MQL) Grinding Using Vitrified CBN Wheels

Bin Shen, Albert J. Shih

ELID Grinding of Sapphire—Experimental Approach

Peidong Han, Ioan D. Marinescu

Machinability Investigation of Micro-Scale Hard Turning of 52100 Steel

G.J. Ellicott, R.E. DeVor, S.G. Kapoor

Session B-3-2: Quality & Metrology 3

CGEC, Room 404

Chair: Mohammed Omar, Clemson University

Co-Chair: Yi Zhou, Clemson University

A Novel Pattern-Based Camera Calibration for 3D Data Acquisition in Reverse Engineering

Qingjin Peng, Chunsheng Yu

Multivariate Process Capability Analysis Using Nonparametric Model and Bootstrap Sampling

Ankit Pahwa, Wenzhen Huang

Employee and Machine Productivity Evaluation Using Manufacturing Information System

Jim Lee, Chun Du, Theodore A. Kozman, William J. Emblom

Noon – 12:30 p.m.

Closing Ceremony and Box Lunch

CGEC, AT&T Auditorium

12:30 – 3:00 p.m.

Industry Tour: BMW Zentrum

Meet at CGEC, Atrium

All Concurrent Sessions are held at the CU-ICAR, Campbell Graduate Engineering Center

*** Student author presenting the paper as part of the Student Research Presentation Contest**



NAMRC 37 REGISTRATION FORM

NAMRC 37: North American Manufacturing Research Conference May 19-22, 2009, CU-ICAR, Greenville, SC, USA

COMPLETE A FORM FOR EACH INDIVIDUAL ATTENDING (INCLUDING COMPANION PROGRAM PARTICIPANTS)

Surname: _____ First Name: _____

Name to appear on nametag: _____

Professional Title: _____

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Zip/Postal Code: _____ Country: _____

Day Phone: _____ Fax: _____

Email: _____

Yes, I have special needs (dietary or disability) Please specify: _____

Yes, I will attend the luncheon on Friday, May 22, 2009

Yes, I will attend the BMW Zentrum Tour, Friday, May 22, 2009

REGISTRATION FEES

All fees are in US Dollars and made payable to the ITESM. Registration fees include entrance to all technical sessions, all conference materials, publications, and meal functions.

Full Conference Registration before April 29, 2008
(SME or NAMRI/SME member #: _____) \$450.00

Full Conference Registration after April 29, 2008
(SME or NAMRI/SME member #: _____) \$500.00

Full Conference Registration before April 29, 2008 (Non-SME or NAMRI/SME member) \$490.00

Full Conference Registration after April 29, 2008 (Non-SME or NAMRI/SME member) \$540.00

Student/Retiree Conference Registration before April 29, 2008
(photocopy of student ID w/registration)** \$175.00

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(photocopy of student ID w/registration)** \$200.00

Companion Program Registration* \$150.00

* for details of what the Companion fee includes, please visit: <http://cidyt.mty.itesm.mx/namrc>

Donation to NAMRI/SME Fund: \$20 ____ \$50 ____ \$100 ____ Other

Total Registration Fees and Miscellaneous Fees: \$ _____ USD

LODGING INFORMATION

Lodging: Lodging is not included in the registration fee and participants are responsible for making their own lodging arrangements. For more information regarding rooms reserved for NAMRC 37, please visit the conference Web site at <http://odce.clemson.edu/namrc/>

PAYMENT INFORMATION

Check/Money Order (in U.S. funds) made payable to: **Clemson University**

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Card Number _____ Expiration Date ____ / ____ Security Code (3 or 4 digits) _____

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Payments and refunds: Payments must accompany the registration form. All attendees, including presenters, must register for the conference. There will be a \$100 processing fee for cancellations made prior to May 11, 2009. **There will be no refunds after May 11.** However, your registration may be transferred to another delegate by contacting Conference Services.

FOR CONFIRMATION OF REGISTRATION, COMPLETE AND RETURN THIS FORM VIA FAX BY MAY 11, 2009 TO:

NAMRC 37 • Clemson University • P.O. Box 912 • Clemson, SC 29633-0912

Phone: 864.656.2200 • Fax: 864.656.7351 • E-mail: jstrange@clemson.edu

Conference Web site: <http://odce.clemson.edu/namrc/>





Connect to education and workforce development

The North American Manufacturing Research Institution (NAMRI/SME) is a significant part of the **Manufacturing Education & Research Community (MER)** of SME. The MER concentrates on the latest education and research in manufacturing through promotion manufacturing careers and educational opportunities that enhance the diverse workforce needs of the manufacturing enterprise.

SME members involved in the MER community and technical groups share knowledge and monitor manufacturing innovation to develop resources and opportunities that advance the industries they serve. SME members can participate in the SME Technical Community Network at any time. If you're not currently an SME member, join today by visiting www.sme.org/edu or call 800.733.4763.

Interested in hosting a future NAMRC?

Since 1973, NAMRC has been held on the campus of a host institution to encourage a dialogue between conference attendees, offer opportunities for laboratory tours and disseminate state-of-the-art manufacturing knowledge. Institutions wishing to host a NAMRC event are encouraged to submit a proposal.

The NAMRI/SME Board of Directors reviews proposals annually. NAMRC site selections are usually made two to three years in advance to allow for adequate planning and promotion. The NAMRI/SME Operating Procedures detail the responsibilities of the host institution and the Society of Manufacturing Engineers. Submission of a written proposal and formal presentation of the proposal at a NAMRI/SME Board of Directors meeting is required. If the proposal is selected, the host institution will enter into a conference agreement with SME. The NAMRI/SME Board of Directors requires conference planning updates at its semi-annual meetings. An outline of information to include when submitting a proposal is online at www.sme.org/namri. The deadline for receipt of the proposals is April 15 to allow for review by the NAMRI/SME Board of Directors prior to their meeting at NAMRC. Proposals should be submitted to:

Mark Stratton
Member and Industry Relations Manager
Society of Manufacturing Engineers
One SME Drive
Dearborn, MI 48121-0930
Phone: 313.425.3307
E-mail: mstratton@sme.org

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NAMRC 37

An International Forum



May 19-22, 2009
Greenville, SC, USA